

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### General presentation

EXHAUST® F1 Evo is a new stabilized ferritic grade and evolution of EXHAUST® F1, welding filler wire widely used since the early 2000s for welding automobile exhaust lines.

While preserving all the many advantages offered by the EXHAUST® F1 for welding stainless steel, whether ferritic or austenitic, and the low carbon steels used in automobile exhaust lines, the EXHAUST® F1 Evo offers several advantages over its predecessor:

- » greater implementation facility for exhaust manufacturers (more widely spread beads that collapse less, brighter beads with fewer projections)
- » significantly improved weld life of the exhausts (gain of approximately 50% by heat cycling between T = 250 and T > 900°C on ferritic assemblies)

### Classification

Stabilized ferritic grade

### Designation

#### Material No.

Europe – EN ISO 14343-A	USA – AWS A5.9	Europe – WNr.
18 L Nb Si	** (430 LNbSi)	

\*\* Usual naming not referenced in the standard AWS A5.9

### Approvals

	MIG	TIG	SAW
TÜV (Germany)			
CE	X	X	X
DB			



**Swiss Steel Group**

Production sites: Ugitech SA  
www.swisssteel-group.com

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

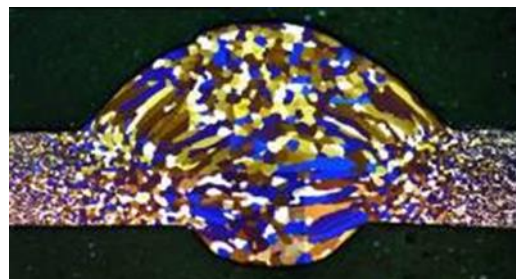
30-09-2021 – REV 05

### Micro structure on welded joints

Edge to edge welded joints of bi-stabilized ferritic 1.4509 plates were made using EXHAUST® F1 Evo filler wire.

The MIG welding conditions were as follows:

- » Base metal thickness: 1.5 mm
- » Filler wire diameter: 1 mm
- » Voltage (smooth): 30 V
- » Welding speed: 208 cm/min
- » Wire speed: 10 m/min
- » Front welding gas: Argon + 2%CO<sub>2</sub> (18 l/min)
- » Back protection gas: Pure Argon (8 l/min)
- » Average resulting intensity: 205 to 215 A
- » Resulting linear welding energy:  
1.80 to 1.95 kJ /cm



MIG edge to edge welding of sheet metal with thickness of 1.5 mm of 1.4509 plates with EXHAUST® F1 Evo filler wire.

### Welded joint corrosion resistance

#### Generalized Corrosion

- » EXHAUST® F1 Evo, because of its high chromium content (18%) produces welds with generalized resistance to corrosion equaling or exceeding the plates it is intended for, in particular for stabilized ferritic sheet metal plates with 17% chromium widely used in automotive exhaust.

#### Localized Corrosion

##### » Intergranular Corrosion

Test ASTM A262-E revealed excellent resistance to intergranular corrosion of ferritic assemblies (thanks to the stabilization of the grade by niobium), even when using high amount of CO<sub>2</sub> in the shielding gas (tested up to 8% of CO<sub>2</sub>).

##### » Corrosion Under Stress

Like all the ferritic grades, EXHAUST® F1 Evo and assembly welds using this wire are not exposed to phenomena of corrosion under stress.



**Swiss Steel Group**

Production sites: Ugitech SA  
[www.swisssteel-group.com](http://www.swisssteel-group.com)

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

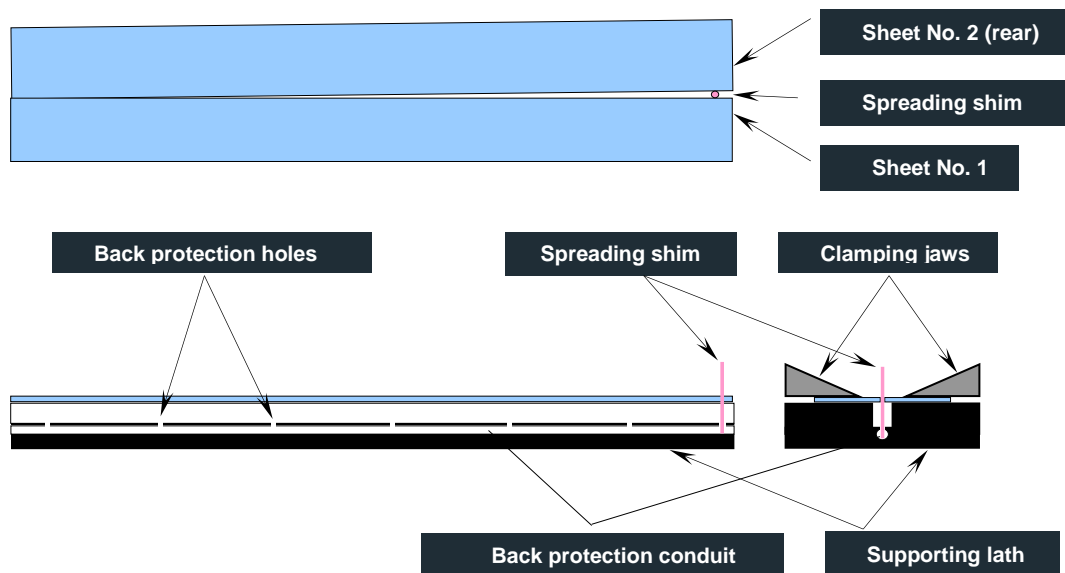
C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### Implementation of MIG wire in « Exhaust » environment

#### Resistance to liquid bath collapse

Specific "resistance to collapse" tests have been performed to simulate the industrial difficulties of obtaining collapse-free welds related to the non-optimum quality of automatic approaches between the parts to be welded. To do this, edge to edge assemblies of thin sheet metal parts (1.5 mm) were made with a continuously variable gap between the plates of between 0 and 1 mm (see the following schematic diagram). Comparatively, we tested EXHAUST® F1 Evo filler wires and wires bearing EXHAUST® F1 and UGIWELD™4370M references. Average abscissas (5 measurements) where collapsing occurred were measured and converted into average deviations between plates.



The following tables summarize the results obtained, demonstrating that EXHAUST® F1 Evo offers far higher performance than EXHAUST® F1 approaching UGIWELD™4370M, allowing us to consider setting up conditions for industrial welding installations that are much easier compared to the trickier arrangements of EXHAUST® F1.



**Swiss Steel Group**

Production sites: Ugitech SA  
www.swisssteel-group.com

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### Average gap (5 measurements) between 1.4509 stabilized ferritic sheets when collapsing.

Grade	Ar gas + 2 % CO <sub>2</sub>	Ar gas + 4 % CO <sub>2</sub>	Ar gas + 8 % CO <sub>2</sub>
EXHAUST® F1	0.31 mm	0.34 mm	0.13 mm
EXHAUST® F1 Evo	0.57 mm	0.58 mm	0.28 mm
UGIWELD™4370M	0.84 mm	0.76 mm	0.49 mm

### Average gap (5 measurements) between austenitic 1.4307 sheets when collapsing.

Grade	Ar gas + 2 % CO <sub>2</sub>	Ar gas + 4 % CO <sub>2</sub>	Ar gas + 8 % CO <sub>2</sub>
EXHAUST® F1	0.46 mm	0.48 mm	0.24 mm
EXHAUST® F1 Evo	0.61 mm	0.63 mm	0.26 mm
UGIWELD™4370M	0.75 mm	0.83 mm	0.53 mm



**Swiss Steel Group**

Production sites: Ugitech SA  
www.swisssteel-group.com

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### Bead appearance

Beads produced with EXHAUST® F1 Evo have fewer projections and are often brighter (less oxidization) than those obtained under the same conditions with EXHAUST® F1 or UGIWELD™4370M.

The following pictures reveal the less oxidized effect observed with EXHAUST® F1 Evo on MIG deposits on austenitic sheet metal in low oxidizing gas (Ar + 2%CO<sub>2</sub>) and in highly oxidizing gas (Ar + 8%CO<sub>2</sub>).

### Shielding gas: Ar + 2%CO<sub>2</sub>

EXHAUST® F1



EXHAUST® F1 Evo



UGIWELD™4370M



EXHAUST® F1



EXHAUST® F1 Evo



UGIWELD™4370M



### Front gas: Ar + 8%CO<sub>2</sub>



**Swiss Steel Group**

Production sites: Ugitech SA  
www.swisssteel-group.com

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### Thermal Fatigue

Resistance of welded joints to "Exhaust" environment obtained, demonstrating an improved life duration of the assemblies using EXHAUST® F1 Evo.

Specific "thermal fatigue" tests were carried out to simulate the up and down cycles in temperature of automotive exhausts and their consequences on the deterioration of exhaust line welded assemblies.

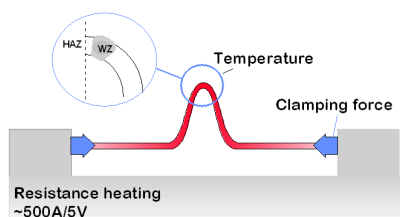
To do this, specimens (see diagram below) were put through cycles ranging from 250 to ~ 935°C (assembly 1) or between 250 and ~ 910°C (assembly 2) through to cracking (reduction of the maximum forces measured on each 50% cycle because of the propagation of a crack).

The following table summarizes the results of the EXHAUST® F1 Evo

» + 50% compared to those obtained with EXHAUST® F1

» + 80% compared to those obtained with UGIWELD™4370M

### Assembly schematic diagram for thermal fatigue



Life duration = nb of cycles from 250°C to 900°C (about 200 s / cycle)  
until 50% reduction of clamping force

### Number of cycles to failure (average of 3 tests per filler wire and assembly)

Grade	Assembly	Nber of cycles with force reduced by 50%	Average
EXHAUST® F1	1	3074	3793
	2	4512	
EXHAUST® F1 Evo	1	4911	5726
	2	6540	
UGIWELD™4370M	1	2624	3207
	2	3790	



Swiss Steel Group

Production sites: Ugitech SA  
www.swisssteel-group.com

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### Welding

EXHAUST® Bi Evo filler wire is designed for welding stabilised ferritic stainless steel sheets, whatever their stabilising element (1.4509, 1.4510, 1.4511, 1.4512, etc.). It can, however, also be used in certain cases for heterogeneous welding of ferritic stainless steel/austenitic stainless steel or austenitic stainless steel/austenitic stainless steel.

The niobium present in the filler grade ensures its stabilisation (essential for preventing intergranular corrosion phenomena in the WM during use).

Although bi-stabilisation with niobium and titanium ensures a stabilised WM, including when highly oxidising and recarburising gases such as argon + 8% CO<sub>2</sub> are used.

### Recommended welding parameters

#### MIG welding

Recommended shielding gases are:

- » Argon + Oxygen (1 to 3%)
- » Argon + CO<sub>2</sub> (1 to 2%)

Nitrogen and hydrogen are prohibited, helium can partially replace argon.

For information, welding conditions to obtain a "spray" regime with 1 mm wire:

- » Voltage 22 to 26V (smooth)
- » Wire speed 9 to 11 m/min
- » Welding speed 100 to 200 cm/min

Inducing average welding intensity of 180 to 250 A and linear welding energy of between 1.8 and 2.2 kJ/cm. For more information, consult us.

To avoid the grain growth in HAZ (Heat Affected Zones), the recommended wire diameter is 1 mm (maximum 1.2 mm). We recommend using a "pulsed" welding method. For the same reasons, multipass deposits are prohibited.

#### TIG Welding

With this process, the welding conditions to be used are the same as those used for EXHAUST® F1 or type 308LSi filler wires, for information:

- » Intensity: 50 to 250 A
- » Voltage: 10 to 15 V
- » Shielding gas: Argon and/or Helium.

Nitrogen and hydrogen are prohibited in shielding gases.



**Swiss Steel Group**

Production sites: Ugitech SA  
www.swisssteel-group.com

# Technical Data Sheet

## EXHAUST® F1 Evo

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	Nb
≤ 0.02	0.5 – 1.5	≤ 0.8	≤ 0.5	17.8 – 18.8	≤ 0,5	≤ 0,5	0.05 + 7x(C+N) – 0.5

30-09-2021 – REV 05

### Heat Treatment

No heat treatment is to be performed before or after welding

### Pickling

For a local pickling, at room temperature, the following bath can be used for a few minutes: 50%vol. water + 45%vol. hydrochloric acid 35% + 5%vol. nitric acid 52%.

There are also pickling pastes designed specifically for the job. Pickling treatment must be followed by rinsing with water and passivation.

### Passivation

Passivation can then be performed in the following cold bath for a few minutes: 75%vol. water + 25%Vol. nitric acid 52%. It must be followed by rinsing in water.

### Available products

Process	Shape	Diameter Range	Packaging	Weight
TIG	Rods	1.0 – 4.0 mm	Cardboard tubes	5 kg
		0.8 – 1.6 mm	Metallic spools – BS 300	15 – 18 kg
MIG	Wire	0.8 – 1.2 mm	Plastic spools – D 200	5 kg
			Plastic spools – D 300	15 kg
		1.0 – 1.6 mm	Plastic spools – D 350	25 – 27 kg
		0.8 – 1.2 mm	Pay off pack - Drums	250 – 500 kg
SAW	Wire	1.6 – 3.2 mm	Rims K415 / 300 / 94	20 – 25 kg
			Rims K435 / 300 / 70	

Contact us for dimensions

### Applications

Developed for the MIG/TIG welds of automobile exhaust lines, EXHAUST® F1 Evo is more generally suitable for welding of the following grades:

- » Stabilized ferritic stainless steels
- » Austenitic stainless steels
- » Low carbon steels (manifold flanges...)

And for homogeneous and heterogeneous sheet metal configurations (i.e. sheets of different grades are welded together).



**Swiss Steel Group**

Production sites: Ugitech SA  
www.swisssteel-group.com